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| **Leak Test Survey** |
| **Pleasant Mount Welding, Inc.** |
| **Standard-Duty Aluminum Interlocking Cover** |
| **Leak Test Survey** |
| **Carbondale, Pennsylvania** |
| **ABE Report No. J23-162** |
| **Revision (00)** |
| **09-Feb-24** |

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**Leak Test Survey**

**DATE:** 09-Feb-24

**PROJECT:**

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| Pleasant Mount Welding, Inc. |
| Standard-Duty Aluminum Interlocking Cover |

**ADDRESS:** Carbondale, Pennsylvania

**ARCHITECT:** -

**ENGINEER:** -

**CONTRACTOR:** PMWI

**NEBB TAB CONTRACTOR:** Air Balancing Engineers, Inc.

**ADDRESS:**

|  |
| --- |
| 1175 N. Vine Street |
| Berwick, PA 18603 |



**PROJECT:** Pleasant Mount Welding, Inc. - Standard-Duty Aluminum Interlocking Cover

**ADDRESS:** Carbondale, Pennsylvania

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| **The data presented in this report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB *Procedural Standard for Testing, Adjusting, and Balancing of Environmental Systems.*** |
| **The measurements shown, and the information given, in this report are certified to be accurate and complete, at the time and date information was gathered. For any abbreviations used in this report please refer to the current edition of NEBB *Fundamental Formulas.*** |

**NEBB TAB CONTRACTOR:** Air Balancing Engineers, Inc.

**REG. NO.** 2412

**CERTIFIED BY:** BART RADO

|  |  |
| --- | --- |
| **DATE:** | 09-Feb-24 |

**SUBMITTED & CERTIFIED BY NEBB CONTRACTOR:**

|  |
| --- |
| Air Balancing Engineers, Inc. |
| Bart Rado |
| 2412 |
| 31-Dec-24 |

|  |
| --- |
| **NEBB** |
| **CERTIFICATION** |
| **SEAL** |

**TAB SUPERVISOR**

**REG. NO. EXPIRATION DATE:**





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| Filename: | 23162 / TOC |

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**GENERAL NOTES AND OBSERVATIONS**

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| **PROJECT:** | **Pleasant Mount Welding, Inc. - Standard-Duty Aluminum Interlocking Cover** |

**EXECUTIVE SUMMARY:**

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| On February 9th, 2024, Air Balancing Engineers, Inc. (ABE) performed a "Extruded Aluminum Cover Leak Test" evaluation at |
| the Pleasant Mount Welding, Inc. manufacturing facility in Carbondale, Pennsylvania. |

|  |
| --- |
| Scope of work included measuring the air leakage rate of a formed flat cover at a specific negative pressure within the tank. |
| Actual leakage rate was compared to the maximum allowable leakage rate. Final Test results yielded an acceptable leakage |
| rate for the Extruded Aluminum Cover Tested during this on-site survey. |

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| Filename: | 23162 / GNO |

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February 9, 2024 ABE Project # 23-162

Extruded Aluminum Cover Leak Test

1. SCOPE:

The objective of this test is to measure the air leakage rate of the Formed Flat Cover at a specific negative (-) pressure within the tank. The test was performed on a “mock–up” tank with the extruded flat cover completely installed. The “mock–up” tank was constructed of plywood with 2’x4’ framing (reference photo #1). To make the tank as airtight as possible, the interior of the structure was sealed with an epoxy sealant and the exterior was sealed with plastic and all joints caulked. With the tank made essentially “*airtight*” the resultant leakage would be that of the extruded aluminum cover. The actual leakage rate of the extruded flat cover was calculated in cubic feet per minute (CFM).

***The actual leakage rate was compared to the maximum allowance leakage rate.***



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1. DESCRIPTION OF SAMPLE COVER PANELS TESTED

There was a total of six (6) cover panels (top mounted) to the PMWI wooden test tank that were evaluated during the leak testing of the PMWI Standard-Duty Aluminum Interlocking Flat Panel Cover system. The wooden tank had inside dimensions of 9’-0” x 9’-0” and the cover panels’ overall cover area was determined to be 89.85 square feet (sq ft.) in the top mounted configuration.

The PMWI cover panels leak tested were fabricated from 6061-T6 aluminum extruded components that comprise the PMWI Standard-Duty Aluminum Interlocking Flat Panel Cover system. There are over 20 extruded aluminum components that are included in the Standard-Duty Interlocking Cover system. There are many male and female components that allow the cover system to be configured in a multitude of ways to achieve project specific requirements for loading as well as geometry of the cover system required.

There are standard components of the cover system which typically comprise over 90% of cover systems and those are the parts that were used to fabricate the cover panels used for leak testing. Please reference attached drawing [RD Leak Test 2 Cover Layout Drawing] showing the fabrication of the cover panels.

All Standard-Duty Aluminum Interlocking Cover panels tested used the 6” wide Cover Plank (CS-1) which is the main component comprising each cover panel. This is typically the case for all cover panels. The CS-1 plank extrusion is the main decking component that the cover system is built upon. The CS-1 plank has double interlocking construction with 2 male protrusions on one side and 2 female receptors on the opposite side of each plank. This allows planks and other extruded components to be assembled together to form a rigid cover panel.

The components for the cover panels tested are listed in the Bill of Materials as shown on the attached drawings.

All of the cover panels (assembly callouts “4C1”, “4C2” and “4C3”) required the use of CS Interlock Edges (CSi-41). The CSi-41 Interlock Edges envelope all the decking components on each side of the panel and are held together by Sikaflex adhesive and aluminum rivets to form rigid cover panels. The Interlock Edges allow the cover panels to be supported by the Interlock Beam (CSi-40w) located at the center of the tank and the Interlock Angles (CSi-44) located at the perimeter of the tank.

Other standard components used to fabricate cover panels include the Interlock Female Handle

(CSi-42) at panel-to-panel interfaces, CS Handle Male (CS-18) used at perimeter panels to allow use of Santoprene gaskets at the top mount locations for air seal protection. Also, at panel-to-panel interfaces the 3” Interlock Underlap extrusions are required (CSi-45 Male at one location and the

CSi-46 Female at one location). The overlap of the Interlock Handles and the 3” Interlock Underlap components allow cover panels to hold down adjacent cover panels.

The other standard component used on all cover panels is the Interlock Slide Latch assemblies (SL- 1 and SL-2) that are contained within the Handles of the system to allow panels to be latched to the support members preventing panel uplift. Also, the Interlock Beams (CSi-40w) and Interlock Angles (CSi-44) provide t-slots for Santoprene gaskets for sealing panels along the edges of cover panels in the direction of the Interlock Edges.

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As stated above, the 6061-T6 extruded components used to fabricate the leak test cover panels are a representative configuration for the most commonly assembled cover panels expected to be used in the vast majority of cover applications. Though there are many additional components comprising the Standard-Duty Aluminum Interlocking Cover system, the use of those parts do not adversely impact the capability of the cover system in regards to air leakage of the system. The same air intrusion leak rates would be expected no matter the configuration of an individual cover panel.

1. REQUIRED EQUIPMENT:

The following equipment was required to perform the leak test:

* + Blower with a capacity of 500 CFM at 1/2- inch w. c. SP.
  + Calibrated orifice plates.
  + Manometer with graduations of a minimum of 0.01 inches in w. c.
  + The equipment used was a Retrotec 400 Series Test Fan Serial Number 4XLF10326 with calibrated orifices and DM-32 Electronic Micromanometer. A series 18 orifice plate was used for testing. Please reference appendix 1 for Certificate of Calibration.

1. LEAK TEST PARAMETERS:
   * Depressurize the structure to (-) 0.20 inches w. c. using the aforementioned test fan assembly.
   * Maximum allowable leakage shall be 0.20 CFM per square foot of cover area or less.
   * Allowable Leakage: 0.20 CFM / Sq. Ft. at 0.20 inches negative pressure. 89.85 sq. ft. x

0.20 CFM / Sq. Ft. = 17.97 Maximum Allowable Leakage

1. LEAK TEST RESULTS:
   * Cover size: 9 ft. 5 inches X 9 ft. 9 ½ inches
   * Total Overall Area of Cover: 89.85 sq. ft.
   * Actual Test Pressure: (-) .2015 in. wc
   * Actual Leakage: 14.00 CFM
   * Actual CFM leakage per square foot of cover panel: 0.1558 CFM / Sq. Ft. (14.00 CFM /

89.85 Sq. Ft.= 0.1558 CFM / Sq. Ft.)

* + Reference photo #2 for image of leak test results.

1. CONCLUSION:

Test results indicate a LEAKAGE RATE of ***0.1558 CFM / Sq. Ft.*** which is less than the MAXIMUM allowable leakage rate of ***0.20 CFM / Sq. Ft.*** indicating the aluminum cover panels tested are acceptable and below the maximum allowable leakage rate.

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# APPENDIX 1

Instrument Calibration

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**INSTRUMENT CALIBRATION REPORT**

|  |  |
| --- | --- |
| **PROJECT:** | **Pleasant Mount Welding, Inc. - Standard-Duty Aluminum Interlocking Cover** |

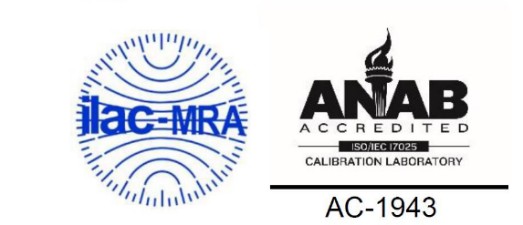
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| --- | --- | --- | --- | --- |
| **MANUFACTURER /** | **MODEL NO.** | **SERIAL NO.** | **CALIBRATION**  **TEST DATE** | **CALIBRATION**  **DUE DATE** |
| **INSTRUMENT** |
| Retrotec | 400 Series | 4XLF10326 | 2020-11-04 | 2025-11-04 |
| Test Fan |



AIR BALANCING ENGINEERS, INC. 2412

Appendix 1

ABE Form V1.091

Calibration laboratory

## Retrotec

**1060 East Pole Road Everson, WA, US 98274**

+1 (360) 738-9835

[calibration@retrotec.com](mailto:calibration@retrotec.com) [http://www.retrotec.com](http://www.retrotec.com/)

This calibration laboratory has been assessed by the ANSI-ASQ National Accreditation Board and meets the requirements of international standard ISO/IEC 17025. All pressure and flow devices used in this calibration are traceable to the International System of Units (SI), consensus standards, or ratio type measurements through national standards realized and maintained by NIST or an NMI.

Device being calibrated:

Description: **Test Fan**

Manufacturer: **Retrotec** Calibrated by: Shelby Zettle Model Number: **400 Series**

Shell Serial Number: **4XLF10326**

Main Voltage: **120 V**

Main Frequency: **60 Hz** Signature

Issued Date: **2020-11-04**

Reference Flow:

LFE 2009 Chamber, in accordance with ANSI/AMCA 210-07: LFE 2009 Chamber, in accordance with ANSI/AMCA 210-07: Device Under Test Gauge: **DM-32** Gauge Serial number **401969** Device Under Test Gauge: **DM-32** Gauge Serial number **401969** Reference Gauge: **DM-32** Gauge Serial number **405346** Reference Gauge: **DM-32** Gauge Serial number **405308**

LFE 2018 (US) Chamber, in accordance with ANSI/AMCA 210- 07:

LFE 2018 (US) Chamber, in accordance with ANSI/AMCA 210- 07:

Device Under Test Gauge: **DM-32** Gauge Serial number **410149** Device Under Test Gauge: **DM-32** Gauge Serial number **410149**

Reference Gauge: **DM-32** Gauge Serial number **412012** Reference Gauge: **DM-32** Gauge Serial number **407737**

Calibration Information:

The Device was calibrated against laboratory standards whose values are traceable to recognized national standards. The uncertainty represents an expanded uncertainty using a coverage factor of k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits without taking uncertainty into account. The uncertainty evaluation has been carried out in accordance with ISO/IEC 17025 requirements.

Calibration Procedure: **Procedure ID No.CP-CHB-01**

This calibration applies only to the unit listed on this certificate.

This Calibration Certificate shall not be reproduced except in full, without written approval from Retrotec.

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Calibration Expiration Date | Name | Calibration Expiration Date |
| ISO 9972 | 2025-11-04 | I.S. EN ISO 9972:2015 | 2022-11-04 |
| CGSB 2002 | 2025-11-04 | ATTMA-TS1 | 2021-11-04 |
| ASTM-E779 | 2025-11-04 | RESNET | 2025-11-04 |

## Calibration Results:

**Flow rates are corrected to STP conditions of 20°C, 101.325 kPa, 50% RH and Air Density: 1.19886**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Range | Humidity % (RH) | Temp (C) | Barometric Pressure (kPa) | Chamber Pressure (Pa) | Fan Pressure (Pa) | Reference Flow (m³/h) | Fan Flow (m³/h) | Error (%) |
| 74 | 45.6 | 22.4 | 101.400 | 251.6 | 257.8 | 202.44 | 200.18 | 1.1% |
| 74 | 45.9 | 22.3 | 101.400 | 252.7 | 1008.3 | 398.23 | 393.35 | 1.2% |
| 74 | 44.4 | 23.1 | 101.400 | 251.0 | 1564.1 | 503.47 | 487.58 | 3.2% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 47 | 46.1 | 22.4 | 101.400 | 260.8 | 318.8 | 89.32 | 92.75 | 3.8% |
| 47 | 46.6 | 22.2 | 101.400 | 249.5 | 2924.6 | 283.05 | 280.70 | 0.8% |
| 47 | 45.0 | 22.8 | 101.400 | 251.4 | 4980.6 | 368.07 | 364.32 | 1.0% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 29 | 48.5 | 21.6 | 101.400 | 253.6 | 412.8 | 38.89 | 39.10 | 0.6% |
| 29 | 45.0 | 22.8 | 101.400 | 247.9 | 2418.8 | 91.70 | 91.32 | 0.4% |
| 29 | 44.7 | 22.8 | 101.400 | 261.1 | 4986.3 | 129.80 | 129.16 | 0.5% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18 | 47.4 | 21.7 | 101.400 | 250.7 | 667.6 | 19.13 | 18.78 | 1.8% |
| 18 | 47.7 | 21.7 | 101.400 | 252.1 | 2651.0 | 38.23 | 37.68 | 1.4% |
| 18 | 47.3 | 22.0 | 101.400 | 249.8 | 5016.0 | 52.74 | 52.16 | 1.1% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11 | 40.9 | 22.4 | 101.100 | 249.4 | 1357.4 | 10.82 | 10.78 | 0.3% |
| 11 | 41.3 | 22.3 | 101.100 | 252.5 | 3085.5 | 16.82 | 16.67 | 0.9% |
| 11 | 39.4 | 23.2 | 101.100 | 249.1 | 5052.7 | 21.65 | 21.66 | 0.0% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7 | 39.1 | 21.9 | 101.100 | 248.3 | 594.0 | 2.31 | 2.32 | 0.4% |
| 7 | 40.4 | 21.3 | 101.100 | 245.4 | 2728.2 | 5.34 | 5.30 | 0.7% |
| 7 | 38.4 | 22.3 | 101.100 | 251.7 | 5289.5 | 7.56 | 7.60 | 0.6% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 49.6 | 17.4 | 101.200 | 249.3 | 961.3 | 0.55 | 0.53 | 3.3% |
| 3 | 49.5 | 18.5 | 101.200 | 252.3 | 2983.8 | 1.23 | 1.22 | 0.8% |
| 3 | 50.0 | 18.5 | 101.200 | 257.4 | 5202.9 | 1.75 | 1.84 | 5.3% |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 74 (Flex) | 46.6 | 21.9 | 101.400 | 252.6 | 273.6 | 203.25 | 199.42 | 1.9% |
| 74 (Flex) | 46.7 | 21.9 | 101.400 | 252.2 | 1038.5 | 392.83 | 388.86 | 1.0% |
| 74 (Flex) | 45.0 | 22.7 | 101.400 | 254.2 | 1586.9 | 487.83 | 477.23 | 2.2% |

Calibration and measurement capability (Expanded Uncertainty): Laminar Flow Elements (0.01 to 3300CFM) = 1.4% of reading + 0.11 CFM. Flow Nozzles (10 to 8200CFM) = 1.5% of reading + 78 CFM. The uncertainty statement is based on a 95% confidence interval, using a coverage of k=2.

## Published Flow Equation Parameters (Units in m³/h):

|  |  |  |  |
| --- | --- | --- | --- |
| Range Configuration | n | k | MF (Pa) |
| 74 | 0.497 | 12.77 | 250 |
| 47 | 0.497 | 5.33 | 250 |
| 29 | 0.479 | 2.20 | 250 |
| 18 | 0.506 | 0.71 | 250 |
| 11 | 0.531 | 0.24 | 250 |
| 7 | 0.544 | 0.07 | 250 |
| 3 | 0.738 | 0.0033 | 250 |
| 74 (Flex) | 0.500 | 12.17 | 250 |

Flow = P^n x k

Where P = Fan Pressure in Pascals

|  |  |  |  |
| --- | --- | --- | --- |
| Range Configuration | K1 | K2 | K3 |
| 74 | 0 | 0.15 | 0 |
| 47 | 0 | 0.12 | 0 |
| 29 | 0 | 0.15 | 0 |
| 18 | 0 | 0.15 | 0 |
| 11 | 0 | 0.14 | 0 |
| 7 | 0 | 0.08 | 0 |
| 3 | 0 | 0.1 | 0 |
| 74 (Flex) | 0 | 0.15 | 0 |

## Date Format:

This report adheres to ISO 8601: Data elements and interchange formats - Representation of dates and times. All dates on this report are in the format: YYYY-MM-DD.

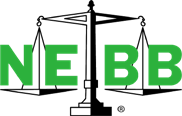
End of report



# APPENDIX 2

ABE Abbreviations

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Cert. No. 2412

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| --- | --- | --- | --- |
| **List of Abbreviations** | | | |
| ACH | Air Changes/Hour | KW | Kilowatt |
| AC / ACU | Air Conditioning Unit | LAT | Leaving Air Temperature |
| AF | Air Foil | LFM | Laminar Flow Module |
| AH / AHU | Air Handling Unit | LD | Linear Diffuser |
| AMPS | Ampere | LWT | Leaving Water Temperature |
| BAS | Building Automated System | MAX | Maximum |
| BHP | Brake Horsepower | MIN | Minimum |
| BI | Backwards Inclined | MU | Make-Up Water |
| BTU | British Thermal Unit | MUA | Make-Up Air |
| BSC | Bio-Safety Cabinet | NA / N/A | Not Applicable |
| BTUH | BTU per Hour | NAV | Not Available |
| CC | Coiling Coil | NR | No Requirement |
| CD | Ceiling Diffuser | OA / OSA | Outside Air |
| CF | Cubic Feet | OBD | Opposed Blade Damper |
| CFM | Cubic Feet per Minute | OD | Outside Diameter |
| CHW | Chilled Water | OP | Operating |
| CHWR | Chilled Water Return | PD | Pressure Drop |
| CHWS | Chilled Water Supply | PH | Phase |
| CT | Cooling Tower | PRV | Pressure Reducing Valve |
| CUH | Cabinet Unit Heater | PSI | Pounds per Square Inch |
| CWR | Condenser Water Return | RA | Return Air |
| CWS | Condenser Water Supply | RG | Return Grille |
| DB | Dry Bulb (Temperature) | RH | Relative Humidity |
| DD | Direct Drive | RLA | Running Load Amps |
| DDC | Direct Digital Control | RPM | Revolutions per Minutes |
| DEG | Degree | RR | Return Register |
| DIA | Diameter | RTU | Roof-Top Unit |
| Dist. | Distance | SA | Supply Air |
| DP | Differential Pressure | SCFM | Standard CFM |
| DWDI | Double Width Double Inlet | SD | Supply Diffuser |
| EA | Exhaust Air | SF | Supply Fan |
| EAT | Entering Air Temperature | SG | Supply Grille |
| EF | Exhaust Fan | SP | Static Pressure |
| EG | Exhaust Grille | SR | Supply Register |
| ER | Exhaust Register | SUP | Supply |
| ERU/ERV | Energy Recovery Unit | SWR | Side Wall Register |
| ESP | External Static Pressure | SWSI | Single Width Single Insert |
| EWT | Entering Water Temperature | TBD | To be determined |
| F | Fahrenheit | TEMP | Temperature |
| FC | Forward Curve | TON | 12,000 BTUH (Cooling Capacity) |
| FCU | Fan Coil Unit | TSP | Total Static Pressure |
| FLA | Full Load Amps | TSTAT | Thermostat |
| FPM | Feet per Minute | T-X | Traverse Test Location I.D. number |
| FPS | Feet per Second | V | Volts |
| FT | Feet | V-X | VelGRID Test Location I.D. number |
| FTR | Fin Tube Radiation | VAV | Variable Air Volume |
| GPM | Gallons per Minute | VD | Volume Damper |
| HC | Heating Coil | VEL | Velocity |
| HD | Head | VER. | Vertical |
| Horz. | Horizontal | VFD | Variable Frequency Drive |
| HP | Horsepower | WB | Wet Bulb Temperature |
| HRU | Heat Recovery Unit | WC | Water Column |
| HZ | Hertz (Cycles per Second) | W.M.S. | Wire Mesh Screen |
| ID | Inside Diameter | WSHP | Water Source Heat Pump |
| IN | Inches | WTD | Water Temperature Difference |

Note: NOT all abbreviations may appear in this report.

APPENDIX 2



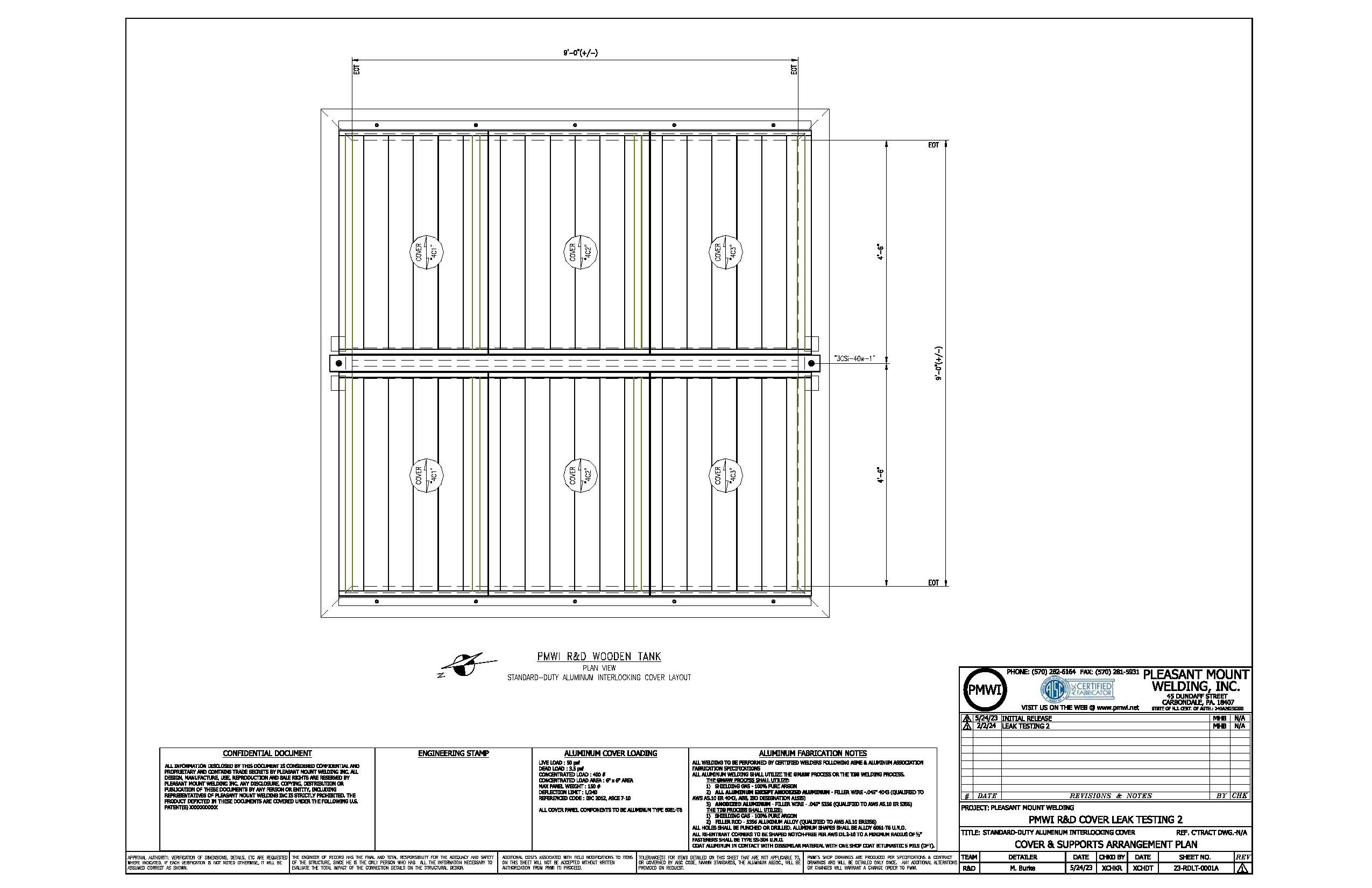
# APPENDIX 3

R&D LEAK TEST COVER DRAWINGS

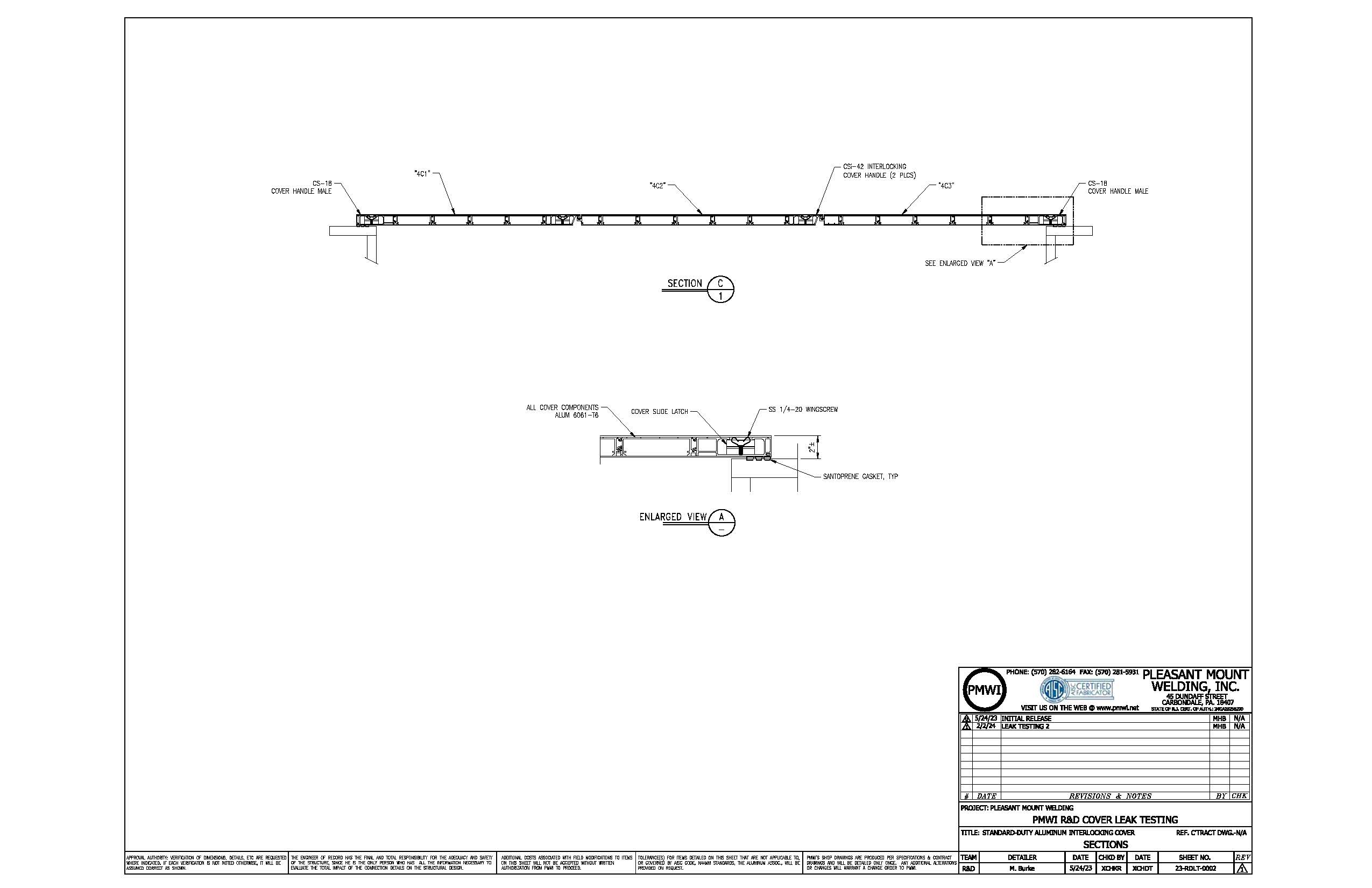
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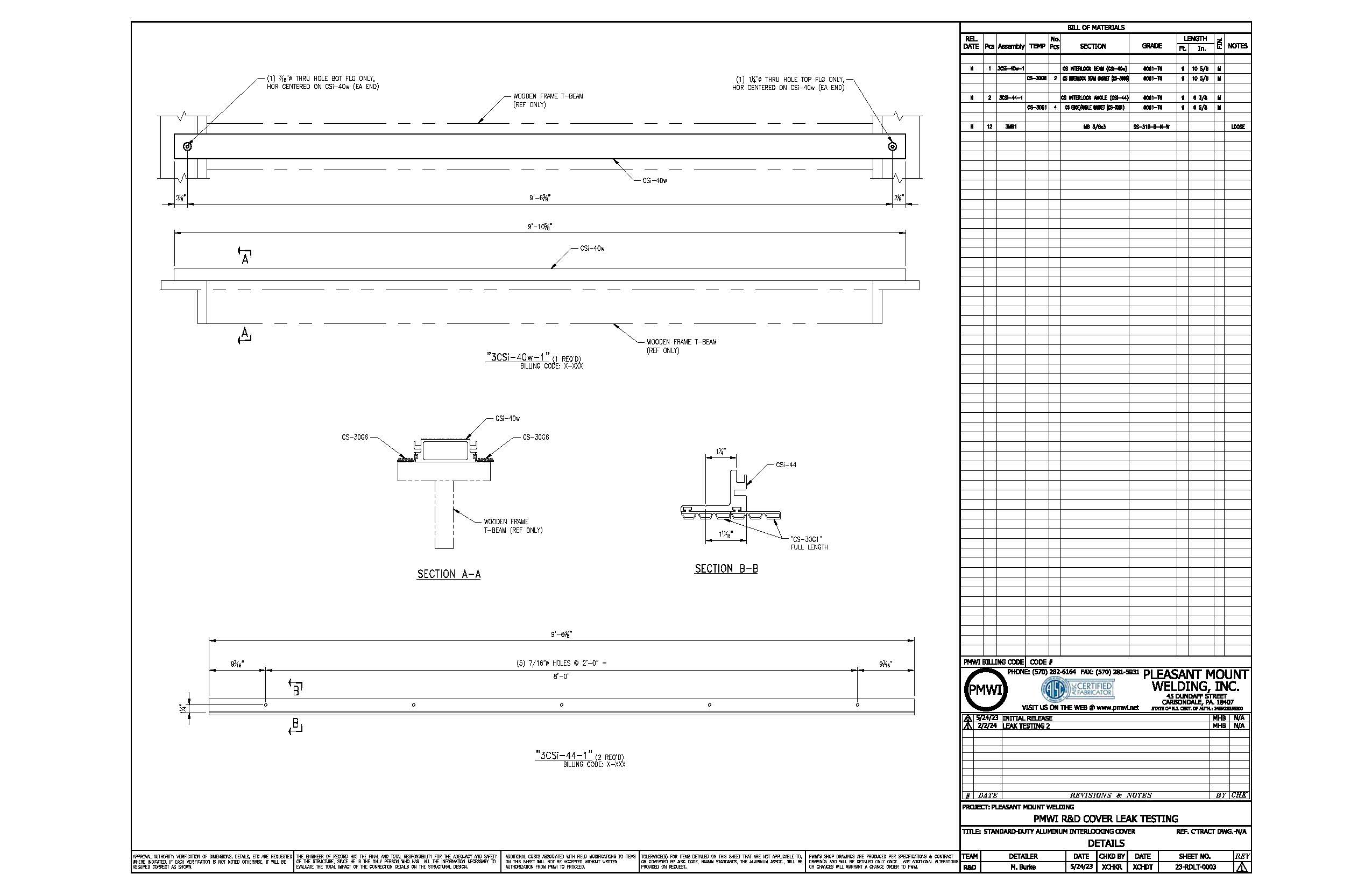


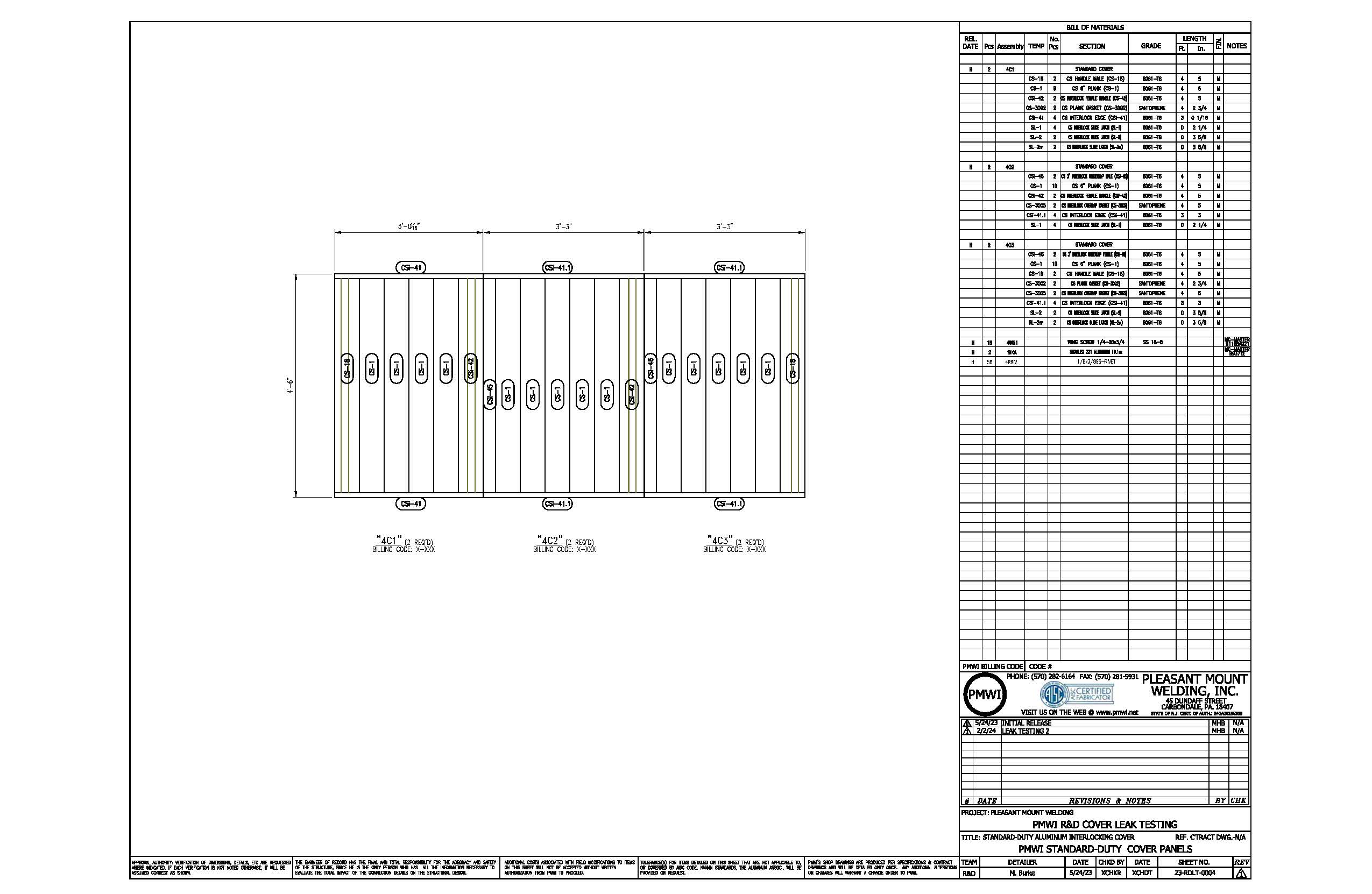
Cert. No. 2412

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